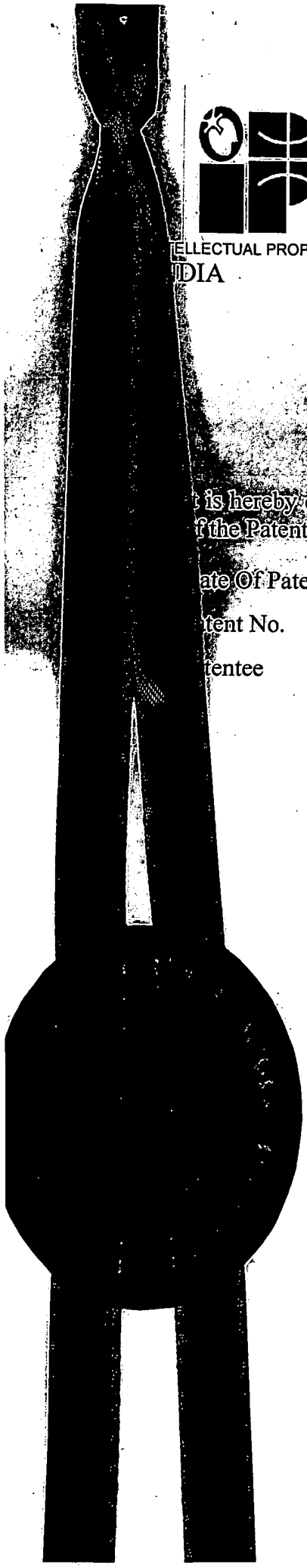

ELLECTUAL PROPERTY
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THE PATENTS ACT

GOVERNMENT OF INDIA
PATENT OFFICE
Ministry of Commerce and Industry
Department of Industrial Policy and Promotion

t is hereby certified that annexed here to is a true copy of **Indian Patent Specification** f the Patent application as granted and detailed below:-

ate Of Patent	:	**07/01/2004**
tent No.	:	**201314 (13/CHE/2004)**
entee	:	**M/s. Wheels India Limited, Padi, Chennai – 600 050, an Indian Company.**

In witness there of
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Dated this the 8th day of September 2010
17th day of Bhadrapada, 1932(Saka)

By Authority of
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CHENNAI – 600 032.

FORM 2

THE PATENTS ACT, 1970.
(39 of 1970)

COMPLETE SPECIFICATION
(See Section 10)

13/CHE/04
07/JAN/04

A METHOD OF MANUFACTURING ONE-PIECE WHEEL OF 5° & 15° DROP CENTER RIMS AND THE ONE-PIECE WHEEL CONSTRUCTION

WHEELS INDIA LIMITED
PADI, CHENNAI 600 050.

Public Limited Indian Company

The following specification particularly describes the nature of invention and the manner in which it is to be performed.

FIELD OF INVENTION

This invention in general relates to road wheels of vehicles. In particular this invention relates to construction of vehicle steel wheel of 5^0 and 15^0 drop center rims used but not limited for commercial use. This invention further relates to a method of manufacturing the said type of wheel.

Tire bead seat area would have a 5^0 or 15^0 taper and profile (where tire contact is involved) as defined in the international tire and rim standards / manuals / hand books such as ETRTO, T&RA, JATMA. Whereas 15^0 drop center is mainly used for tubeless type tyre application, the 5^0 drop center rims can be used for both tube and tubeless applications. Removable flanges are not required for this design.

This invention relates to a construction, apparatus and a method of producing a one-piece wheel of $5^0$and 15^0 drop center rim, providing a generally circular steel blank from a sheet stock of pre-determined uniform thickness, the blank is preferably with a center hole pierced to a predetermined size. The blank is preformed in spinning machine to a predetermined profile & cylindrical shape, such preform is further spun and flow formed in a spinning machine, the preform being positioned between an outer roller & inner mandrel and held against the clamping plate, such inner mandrel comprise of a outboard surface which conforms to the predetermined inner diameter of the rim well, the inner & outer bead-seat and outer flange and such outer roller comprise of outboard surface which confirms to the predetermined inner diameter of the inner flange. The preform peripheral cylindrical portion is then spun against the outboard surface of the inner mandrel & outboard surface of the outer roller to a predetermined profile & form in respect of well, inner & outer bead-seats, inner & outer flanges respectively. The spun rim comprising of predetermined semi-finished well, inner & outer bead seats and inner & outer flanges is further subjected to a flow-forming & spinning operation in an spinning machine, while the disc portion being accurately located in the center hole & clamped against the outer clamping plate, the rim peripheral portion being positioned between an inner mandrel and outer roller, such inner mandrel & outer roll comprise of a outboard surface which conforms to the final profile & shape of the well, inner & outer bead seats and the inner & outer flanges, to achieve the final profile and shape of the well, inner & outer bead-seats and the outer & inner flanges.

PRIOR ART

In its most conventional form, a fabricated sheet steel wheel of 5^0 and 15^0 drop center rim; the rim inner periphery have welded or jointed central disc also made of sheet steel. The tire mounts on the outer periphery of the rim supported by the central disc, which provides a means of attachment to spindle hubs, brake drum or other like associated parts of the vehicle. It is essential that the rim and disc, in their assembled relationship, insure perfect roundness of the rim and accurate axial alignment of the rim with respect to the disc. Deviations in the respective directions being termed as "radial" and "axial" run-outs, the Vehicle manufacturers establish extremely rigid specifications in the tolerances for these dimensions.

When such wheels are manufactured in the conventional method, the rim and discs are normally made as separate components. These two components are then assembled together; the disc fixed at its outer peripheral flange to the inner periphery of the rim by welding or some other like method to form the complete wheel assembly. In the conventional method of making the rims by using a butt-welded

hoop made out of a steel strip of hot rolled sections or plate, achieving such a close tolerance on the roundness has found to be extremely difficult due to the localized "kink" in the region of butt welded joint and the spring back during the rim diameter calibration operation. Further substantial distortion due to welding the two parts requires further corrective additional costly operation to ensure that the axial alignment between the rim and the disc is held within limits. It is appreciated by the people who are skilled in the manufacturing wheels that such distortion once occurred cannot be corrected completely. Such shift in the axial alignment and also the localized kink in the rim in the region of the butt welded joint is know to produce first harmonics during vehicle running causing vibration and high noise. The axial shift between the disc and the rim also produces imbalance of the wheel causing vehicle disturbance or thumping/ shake.

Further when such wheels have been run with test overloads to induce failure, fatigue cracks have usually occurred in the center of the disc where it is attached to its supporting axle and in the welds, which have attached the rim to the disc.

Further a welded assembly does not lend itself well to the rigorous balancing and centering of the wheel. Further the butt-welded joint of the hoop of the rim for the conventional process does not always lead to an airtight construction, which is necessary for fitting tubeless tires. Further the joint also constitutes a weak point, which restricts the useful life. The use of one piece wheels made from our invention, would lead to a noticeable reduction in weight as a whole and achieving balancing and centering, besides ensuring the air-tightness necessary when using tubeless tires.

It is well recognized that wheels are not only critical to the safety of an automotive vehicle but also being an un-sprung mass has a pronounced effect on vehicle stability and driving comfort. It is thus obvious that only a one-piece wheel of 5^0 and 15^0 design and a method of manufacturing the same would satisfy the requirement as enumerated as above.

However, up to the present time none of the prior processes has enabled one-piece steel wheels of $5^0$and 15^0 drop center rims to be produced under satisfactory technical and /or economic conditions, either on account of the fact that they do not lend themselves to mass production at an attractive cost price, or on account of the fact that the wheels obtained do not satisfy the requirements of the users, strength, minimal unbalance, first harmonic content, and accuracy of the significant dimensional characteristics.

The present invention relates to a construction, apparatus and method for producing one-piece wheel of $5^0$and 15^0 drop center rim for vehicles, which lends itself particularly well to mass production and provides wheels which meet the requirements of users such as have been enumerated above. A vehicle wheel of one-piece construction requires less material input and is substantially simpler to fabricate as there is only one part that is needed to manufacture and there are no assembly & welding steps involved, thus resulting in cost savings.

OBJECTS OF THE INVENTION

Accordingly, it is an object of the present invention to provide a steel wheel of one-piece wheel of $5^0$and 15^0 drop center rim construction, a method and apparatus for making the same, which overcome the aforementioned problems in an economical and reliable manner.

It is another object of invention to provide an improved method of manufacturing of a vehicle wheel in a way that reduces manufacturing cost while providing high strength wheel.

It is further object of invention to provide for a design / construction that reduces the wheel weight substantially, yet providing the high strength wheel.

It is yet another object of invention to provide for a greater air space for a larger envelope brake components for improved braking performance.

It is still another object of invention to provide for a wheel having very low radial and lateral run outs.

Yet another object of invention is to provide for a wheel having very low first harmonic content.

It is another object of invention to provide for a wheel having very low unbalance.

It is another object of invention to provide a method whereby a family of vehicle wheels having any plurality of axial width; diameter and offset may be produced from the blanks.

It is another object of invention to provide which would improve uniformity characteristics and increased fatigue life.

A further object is to provide improved apparatus of the aforementioned character, which is economical to set-up, and adjust.

Another object of the invention is to provide an improved manufacturing system, which requires only relatively small number of process steps, which can be carried out efficiently, and economically by automated equipment.

SUMMARY OF THE INVENTION

The invention provides a method of manufacturing a one-piece wheel of 5^0 and 15^0 drop center rim of the type having well, inner & outer bead-seat and flanges wherein the said method comprises the following steps

providing a generally circular steel blank, preferably of predetermined uniform thickness and size, with a center hole pierced, and

the blank is preformed to a predetermined cylindrical shape & size by spinning & flow forming in a CNC spinning machine, the blank being positioned & clamped between an inner mandrel and a clamping plate, such inner mandrel having an outboard surface which conforms to a predetermined inner diameter wherein the well, inner & outer bead seats and the outer flange are formed in the subsequent operations, and

the spun and flow formed preform to a predetermined cylindrical shape & size is further spun in a CNC spinning machine to reduce thickness consequently to increase the width in the forward direction to a predetermined size while maintaining the predetermined inner diameter wherein the well, inner & outer bead seats and the outer flange are formed in the subsequent operations and at the same time further spinning is preformed on the peripheral portion of the cylinder to

displace the material in the backward direction to a predetermined shape & size of the inner flange, and

the preform from the previous step, is further spun in a CNC spinning machine to impart final shape and profile to the rim portion comprising of well, inner & outer bead seats and inner & outer flanges using such inner mandrel, the central line axis of which is slightly offset against the centerline of the central hole of the preform during spinning operation.

One aspect of the present invention is a unique backward & forward material displacement and use of a mandrel that is offset against the axis of rotation of the preform. The cold spinning & flow forming method for manufacturing one-piece wheel of $5^0$and 15^0 drop center rim construction, provides a generally circular steel blank from a sheet stock of pre-determined uniform thickness, the blank is preferably with a center hole pierced to a predetermined size. The blank is preformed in a spinning machine to a predetermined profile & cylindrical shape, such preform is further spun and flow formed in a spinning machine, the preform being positioned between an outer face plate & inner mandrel held against the clamping plate, such inner mandrel comprise of a outboard surface which conforms to the predetermined inner diameter of the rim, well, the inner & outer bead-seat & outer flange and such outer face plate comprise of outboard surface which confirms to the predetermined inner diameter of the inner flange. The preform peripheral cylindrical portion is then spun against the outboard surface of the inner mandrel & outboard surface of the outer roll to a pre-determined profile & form in respect of well, inner & outer bead-seats, outer & inner flanges respectively to displace the material in both backward & forward direction. The spun rim comprising of predetermined semi-finished well, inner & outer bead seats and flanges is further flow-formed and spun in a spinning machine, while the disc portion being accurately located in the center hole & clamped against the outer clamping plate, the rim peripheral portion being positioned between an inner roll and outer shaping roller, such inner mandrel & outer shaping rollers comprise of a outboard surface which conforms to the final shape of the well, inner & outer bead seats and the inner & outer flanges, to achieve the final profile and shape of the well, inner & outer bead-seats and the outer& inner flanges.

The spun wheel comprising of final well, inner & outer bead seats and before displacing the material in both backward & forward direction, the preform is subjected to such operations where the central hole, mounting holes and the vent holes are pierced to a required size.

After final rim profiling & shaping operation, the center hole and the mounting holes are machined accurately in a multi-drilling machine.

After the center hole and the mounting holes are machined accurately in a multi-drilling machine, the inner & outer flange is machined to achieve a flat or round radius on its crown edges.

The principal objects of the present invention are to provide a unique, low cost method of press forming, spinning & flow forming one-piece vehicle steel wheels and the like. Steel blank is formed from sheet stock, and is spin and flow formed in a spinning operation to reduce manufacturing costs. The spinning & flow forming technique employs tools with a simple forming surfaces, which minimizes their associated manufacturing cost, as well as repair expenses. The spin forming machine can be easily programmed to form different shapes, such that the present method is

especially suited for making specialty and/or low volume wheel designs as well as particularly well adapted for manufacturing one-piece type vehicle wheels for bulk manufacturing.

These and other advantages of the invention will be further understood and appreciated by those skilled in the art by reference to the following written specification, claims and appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawing is intended to provide further understanding of invention and is incorporated in and constitutes a part of invention. The drawings illustrate an embodiment of invention and together with the description illustrate principle of invention.

The drawings should not be taken as implying any necessary limitation on the essential scope of invention.

The drawings are given by way of non-limitative example to explain the nature of the invention.

For a more complete understanding of the instant invention reference is now made to the following description taken in conjunction with accompanying drawings.

The various feature of novelty which characterize the invention are pointed out specifically in the claims which a part of description. For a better understanding of the invention, its operating advantage, specific objects obtained by its use, reference should be made to the drawings and descriptive matter is which there are illustrated and described preferred embodiments of invention.

Referring now to drawings, where like numerals designate identical or corresponding parts throughout the referred views.

Fig 1 – shows a sectional view of disc steel blank with center hole of the welded wheel of 5^0 and 15^0 drop center rim construction wheel of the prior art.

Fig 2 - shows sectional view of a spin & flow formed steel disc of the welded wheel of 5^0 and 15^0 drop center rim of the prior art

Fig 3 – shows sectional view of a finished disc of the welded wheel of 5^0 and 15^0 drop center rim of the prior art having mounting and vent hole.

Fig 4 – shows a schematic representation the welded hoop from flat plate for the manufacture of steel rims for welded wheel of 5^0 and 15^0 drop center wheels of the prior art

Fig 5 - shows a schematic representation the welded hoop from mill section for the manufacture of steel rims for welded 15^0 drop center rim of the prior art

Fig 6 - shows a schematic representation the rolling process involved in producing rims for welded wheel of 5^0 and 15^0 drop center rim of the prior art

Fig 7 - shows a schematic representation of the calibration operation of the welded wheel of 5^0 and 15^0 drop center rim of the prior art

Fig 8 - shows a schematic representation of the vent hole operation of the welded wheel of 5^0 and 15^0 drop center steel rim of the prior art

Fig 9 - shows a schematic representation of the disc and rim assembly after welding operation of the welded 5^0 and 15^0 drop center rim of the prior art.

Fig 10 – shows a perceptive view of the one-piece steel wheel for 5^0 and 15^0 drop center rims in accordance with the present invention.

Fig 11– shows a sectional view of disc steel blank with center hole of the one-piece steel wheel for 5^0 and 15^0 drop center rims in accordance with the present invention.

Fig 12 – shows a schematic representation of the first stage of spinning process of the one-piece steel wheel for 5^0 and 15^0 drop center rims in accordance with the present invention.

Fig 13 – shows a schematic representation of the spun wheel from the previous step, wherein the mounting and center hole is pierced in accordance with the present invention.

Fig 14 - shows a schematic representation of the spun wheel from the previous step wherein the vent holes are pierced in accordance with the present invention.

Fig 15- shows a schematic representation of the second stage of forward and backward displacement of material during spinning process of the one-piece steel wheel for 5^0 and 15^0 drop center rims in accordance with the present invention

Fig 16 – shows a schematic representation of the final stage of spinning processes where the well, inner & outer bead-seats and inner & outer flanges are formed to the final profile and shape in accordance with the present invention.

Fig 17 – shows a schematic representation of the machining process for providing a flat or rounded edges on the inner and outer flange crown edges.

DETAILED DESCRIPTION OF THE PRIOR ART AND THE PREFERRED EMBODIMENTS

DESCRIPTION OF THE PRIOR ART

The conventional method of producing the steel wheel is shown in Fig 1 to Fig 9. In the conventional method the disc and the rim are manufactured as separate components and then welded or jointed by other means after assembly

The steps involved in the manufacture of steel discs are blanking of the circular blank of pre-ermined thickness, spinning & flow forming and piercing the center spigot, mounting and vent holes as shown in Fig 2 and Fig 3 respectively.

The rim is manufactured either by using a flat steel plate of uniform thickness or using the profiled hot rolled steel plate as shown in Fig 4 and Fig 5. In either case the steel plate is coiled into a hoop, butt welded, joint trimmed and dressed. The hoops are roll formed in a rolling machine to impart final profile & shape to the rim as shown in Fig 6. Finally the rims are calibrated for the diameter and out-of roundness accuracy as shown in the Fig 7. The valve access hole is subsequently pierced in press as shown in Fig 8

These two components are then assembled together; the disc fixed at its outer peripheral flange to the inner periphery of the rim by welding or some other like method to form the complete wheel assembly. The wheels subsequently under goes several machining steps to machine center hole and bolt holes.

DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

Our preferred embodiment of invention is shown in Fig 10 to Fig 16. The following description is of the best presently contemplated mode of carrying out the invention. This description is made for the purpose of illustrating the general principles of the invention and should not be taken in a limiting sense. The scope of the invention is best determined by reference to the appended claims

The first step of manufacturing a one-piece wheel of 5^0 and 15^0 drop center rim involves a spinning and flow forming operation as shown in Fig 12, where in the steel blank of pre-determined diameter and thickness Fig 11, the blank is preferably with a center hole pierced to a predetermined size, is spun and flow formed in a CNC 4-axis spinning machine. The operation is now explained in greater detail .The preformed steel blank is held between inner mandrel M1 and the clamping plate C1. The roller R1 mounted on CNC hydraulically actuated slide, impart rolling pressure on the outer peripheral portion of the preformed blank to reduce the thickness at the required region and at the same time impart predetermined cylindrical shape and profile as per the predefined machine program. The outboard surface of the inner mandrel M1 corresponds to such predetermined cylindrical shape & profile corresponding to the inner diameter of rim portion.

The next step involves piercing the central hole, mounting & vent holes in a conventional press as shown in the Fig 13 & Fig 14.

The next step involve forward spinning to extend the cylindrical portion comprising of well, inner & outer bead seat and outer flange to an cylindrical shape of predetermined inner diameter and width as shown in Fig 15 and at the same time cylindrical portion comprising of inner flange is spun in such a way that the material is displaced in the backward direction, as shown, to a predetermined inner diameter and width. The operation is now explained in greater detail. The preform as shown in Fig 15, is spun and flow formed in a CNC 4-axis spinning machine. The preform is positioned between inner mandrel M2 and outer roll F2 and clamped prior to spinning operation by the clamping plate C2. The roller R2 mounted on CNC hydraulically actuated slide impart rolling pressure on the outer peripheral of the preformed blank to reduce the thickness at the required region and at the same time extend the cylindrical portion to a predetermined shape and profile as per the predefined machine program. The outboard surface of the inner mandrel M2 corresponds to the predetermined inner diameter of the rim while the outboard surface of the outer roll F2 corresponds to the predetermined inner diameter of the inner flange. The roller R2 is used for both forward and backward spinning as shown in the drawing.

The next step involves final profiling of the rim comprising of well, inner & outer bead seats and inner & outer flanges as shown in Fig 16 The spun rim comprising of predetermined semi-finished well, inner & outer bead seats and flanges is further formed in a spinning machine, while the disc portion being accurately located in the center hole & clamped against the outer clamping plate, the rim peripheral portion being rolled between an inner mandrel and outer shaping rollers mounted, such inner mandrel and outer rollers comprise of a outboard surfaces which conforms to the final

shape of the well, inner & outer bead seats and the inner & outer flanges, to achieve the final profile and shape of the well, inner & outer bead-seats and the outer& inner flanges. The operation is now explained in greater detail. The preform from the previous operation is located in the central hole and clamped against the clamping plate C3. The inner mandrel, the central line axis of which slightly offset against the centerline of the central hole of the preform moves in to an exact predetermined position. The outboard surface of the inner mandrel M3 corresponds to the final profile of the well and the bead seat. The shaping roll R3 mounted on a slide moves in from outward direction to form the profile of well and bead seat. At the same time the rolls R1, R2, R4 and R5 moves into position to form the profile of the inner and outer flanges.

SALIENT FEATURES OF THE INVENTION ARE AS FOLLOWS

A design / construction of a one-piece steel wheel of 5^0 and 15^0 drop center rim construction of the type having an integral disc and rim portion with inner & outer 5^0 and 15^0 bead-seat, well and the inner & outer flanges

A method of producing the wheel consists in providing a generally circular blank; spin forming the blank to a pre-determined thickness and profile. The blank is preferably with a center hole pierced to a predetermined size. The blank is spun in a spinning machine, the bank being positioned and clamped between a mandrel and a clamping plate, such inner mandrel having a outboard surface which conforms to the predetermined inner diameter of the rim comprising of well, bead seats and flanges. The blank peripheral portion is spun and flow formed against the outboard surface of the inner mandrel to the predetermined diameter as explained above.

The method has the step of spin forming the peripheral portion of the blank by engaging the same with a forming roller so as to obtain controlled thickness reduction and shape in the peripheral cylindrical portion of the blank.

The method has the step of displacing the material in backward direction, a section of the preform cylindrical peripheral portion against the outboard shaping surface of the mandrel and an outwardly positioned facing plate to form the predetermined shape of the inner flange.

The method has the step of spin forming a section of the preform cylindrical peripheral portion by engaging the same with a forming roller to form the predetermined shape of the well, bead seats and flanges.

The method has the step of spin forming the bead seat portion of the preform outboard section against the shaping surface of the mandrel to form the predetermined shape of flange.

The final profiling method has an inner mandrel, axis of rotation of which slightly offset against the axis rotation of the preform.

A method has the step wherein first-named spin forming step includes a plurality of passes of the forming roller.

A method has the step wherein after first step of spinning operation bolt holes on pierced in a conventional press.

A method has the step wherein after piercing the bolt holes, vent holes are pierced in a conventional press

The method also includes the step of providing a disc blank of substantially uniform thickness and constructed also from low carbon steel of HSLA steel composition.

Throughout this detailed description, reference is made to the tools and dies that perform the various shaping operations. Because the tooling used in each of the shaping operations is conventional devices, which are well known in the metal stamping/forming arts, detail description of the same has not been provided.

It is to be understood that the invention may assume various alternative orientations and step sequences, except where expressly specified to the contrary. It is also to be understood that the specific devices and processes illustrated in the attached drawings, and described in the following specification are simply exemplary embodiments of the inventive concepts defined in the appended claims. Hence, specific dimensions and other physical characteristics relating to the embodiments disclosed herein are not to be considered as limiting, unless the claims expressly state otherwise.

Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be regarded as falling within the scope of the invention as defined by the claims that follow.

WE CLAIM

1. A method of manufacturing a one-piece wheel of 5^0 and 15^0 drop center rim of the type having well, inner & outer bead-seat and flanges wherein the said method comprises the following steps

   providing a generally circular steel blank, preferably of predetermined uniform thickness and size, with a center hole pierced, and

   the blank is preformed to a predetermined cylindrical shape & size by spinning & flow forming in a CNC spinning machine, the blank being positioned & clamped between an inner mandrel and a clamping plate, such inner mandrel having an outboard surface which conforms to a predetermined inner diameter wherein the well, inner & outer bead seats and the outer flange are formed in the subsequent operations, and

   the spun and flow formed preform to a predetermined cylindrical shape & size is further spun in a CNC spinning machine to reduce thickness consequently to increase the width in the forward direction to a predetermined size while maintaining the predetermined inner diameter wherein the well, inner & outer bead seats and the outer flange are formed in the subsequent operations and at the same time further spinning is preformed on the peripheral portion of the cylinder to displace the material in the backward direction to a predetermined shape & size of the inner flange, and

   the preform from the previous step, is further spun in a CNC spinning machine to impart final shape and profile to the rim portion comprising of well, inner & outer bead seats and inner & outer flanges using such inner mandrel, the central line axis of which is slightly offset against the centerline of the central hole of the preform during spinning operation.

2. The method as claimed in claim 1 wherein spin forming the peripheral of the blank by engaging the same with a forming roller so as to obtain controlled thickness reduction and shape in the peripheral and inner portion of the blank.

3. The method as claimed in claims 1 & 2 wherein the material is displaced in the backward direction during spinning a portion of the preform peripheral cylindrical portion against the outboard surface of an outwardly positioned outer roll to form a predetermined cylindrical portion of the inner flange.

4. The method as claimed in claims 1 to 3 wherein spin forming a portion of the blank peripheral portion by engaging the same with a forming roller to form the final shape of the well.

5. The method as claimed in claims 1 to 4 wherein spin forming a portion of the blank peripheral portion by engaging the same with a forming roller to form the final shape of the bead seat.

6. The method as claimed in claims 1 to 5 wherein spin forming the bead seat portion of the preformed blank is carried out by engaging the same with a forming roller against the outboard surface of the outer mandrel to form the final shape of outer flange.

7. The method as claimed in claims 1 to 6 wherein the first-named spin forming step consists a plurality of passes of the forming roller.

8. The method as claimed in claims 1 to 7 wherein after finish spinning operation boltholes are pierced in a conventional press.

9. The method as claimed in claims 1 to 8 wherein after piercing the center hole, bolt holes, vent holes are pierced in a conventional press.

10. The method as claimed in claims 1 to 9 wherein after piercing the center, bolt holes & vent holes, the center hole and the mounting holes are accurately machined to required size.

11. The method as claimed in claims 1 to 10 wherein after machining the center hole and the mounting holes to an accurate required size, the inner & outer flange crown edges are machined to provide a radius or a flat.

12. The method as claimed in claims 1 to 11 wherein the disc blank provided is of low carbon steel or HSLA steel composition.

13. The method as claimed in claims 1 to 12 wherein a butt-welded hoop of predetermined diameter, width and thickness can also be used instead of a blank.

14. The method as claimed in claims 1 to 13 wherein the butt-welded hoop of predetermined diameter, width and thickness can also be used to manufacture the rim part alone.

15. A one-piece wheel of 5^0 and 15^0 drop center rim having an integral disc and rim portion is made from a circular blank or hoop by the method as claimed in claims 1 to 14.

16. A method of manufacturing a one-piece wheel of 5^0 and 15^0 drop center rim of the type having well, inner & outer bead-seat and flanges substantially as herein described with reference to the accompanying drawings.

Dated this the 7th day of January 2004.

For WHEELS INDIA LIMITED

B. Srivatsan
VICE PRESIDENT (FINANCE) & SECRETARY

Signature of Applicant

ABSTRACT

This invention relates to a construction, apparatus and a method of producing a one-piece wheel of $5^0$and 15^0 drop center rim, providing a generally circular steel blank from a sheet stock of pre-determined uniform thickness, the blank is preferably with a center hole pierced to a predetermined size. The blank is preformed in spinning machine to a predetermined profile & cylindrical shape, such preform is further spun and flow formed in a spinning machine, the preform being positioned between an outer roller & inner mandrel and held against the clamping plate, such inner mandrel comprise of a outboard surface which conforms to the predetermined inner diameter of the rim well, the inner & outer bead-seat and outer flange and such outer roller comprise of outboard surface which confirms to the predetermined inner diameter of the inner flange. The preform peripheral cylindrical portion is then spun against the outboard surface of the inner mandrel & outboard surface of the outer roller to a predetermined profile & form in respect of well, inner & outer bead-seats, inner & outer flanges respectively. The spun rim comprising of predetermined semi-finished well, inner & outer bead seats and inner & outer flanges is further subjected to a flow-forming & spinning operation in an spinning machine, while the disc portion being accurately located in the center hole & clamped against the outer clamping plate, the rim peripheral portion being positioned between an inner mandrel and outer roller, such inner mandrel & outer roll comprise of a outboard surface which conforms to the final profile & shape of the well, inner & outer bead seats and the inner & outer flanges, to achieve the final profile and shape of the well, inner & outer bead-seats and the outer& inner flanges.

13/C MF/04
07/PAN/04

NAME OF THE APPLICANT: WHEELS INDIA LIMITED

SHEET 1 OF 3 SHEETS

Application No. 0013/CHE/04

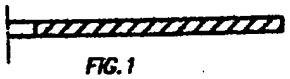


FIG.1

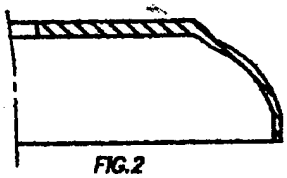


FIG.2

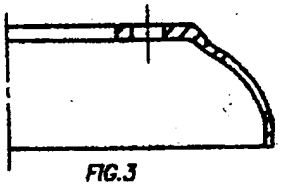


FIG.3

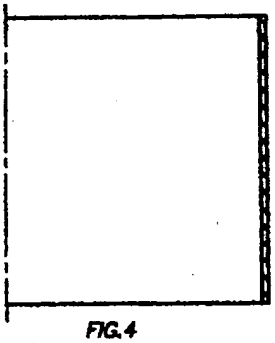


FIG.4

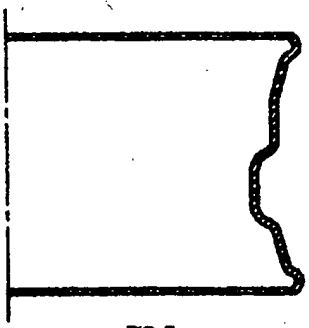


FIG.5

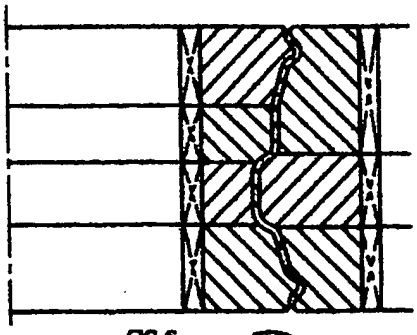


FIG.6

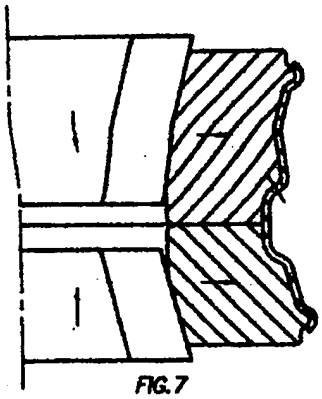


FIG.7

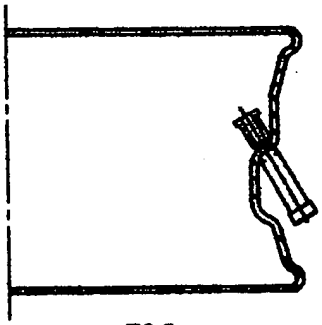


FIG.8

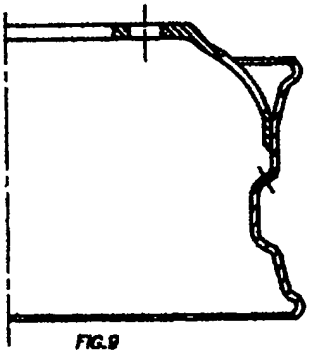


FIG.9

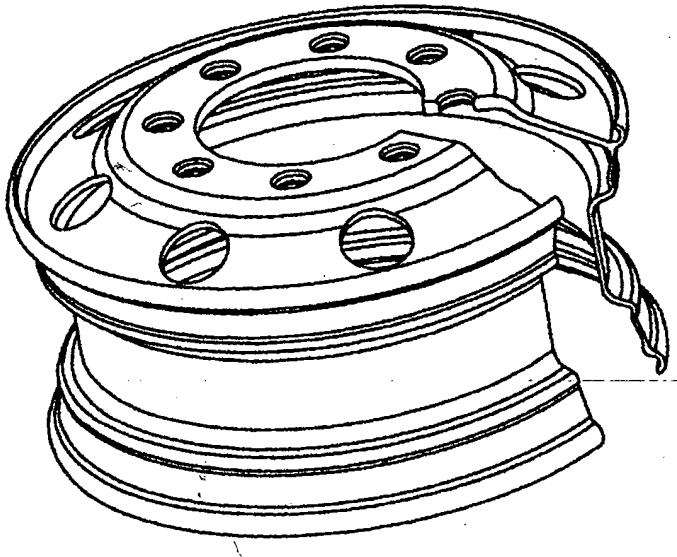
PRIOR ART 15° DROP CENTRE STEEL WHEEL

SIGNATURE OF APPLICANT: (S.SRIVATHSAN)

NAME OF THE APPLICANT: WHEELS INDIA LIMITED

NAME OF THE APPLICANT: WHEELS INDIA LIMITED

Application No. 0013/CHE/04



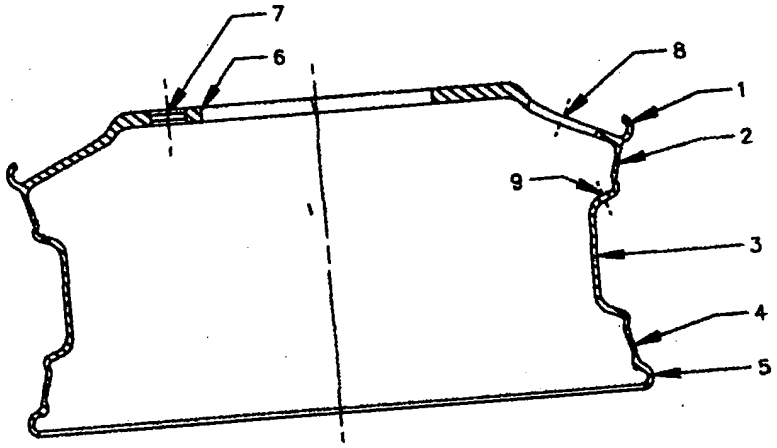


FIG.10

SIGNATURE OF APPLICANT: (S. SRIVATHSAN)

NAME OF THE APPLICANT: WHEELS INDIA LIMITED

Application No. 0013/CHE/04

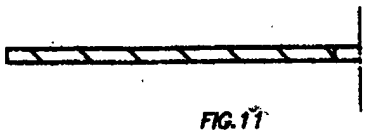


FIG.11

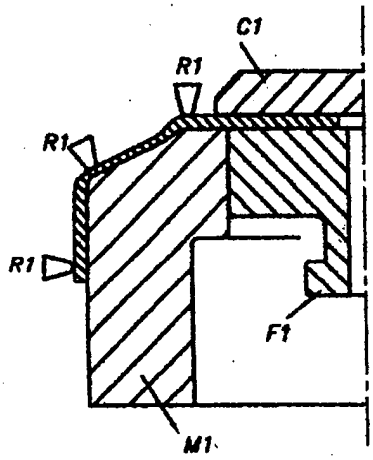


FIG.12

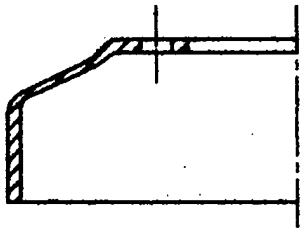


FIG.13

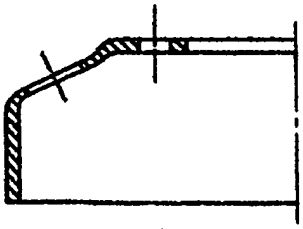


FIG.14

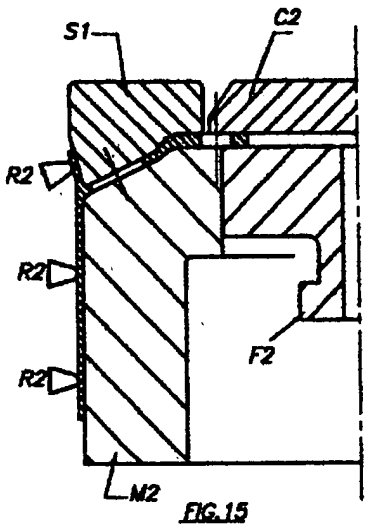


FIG.15

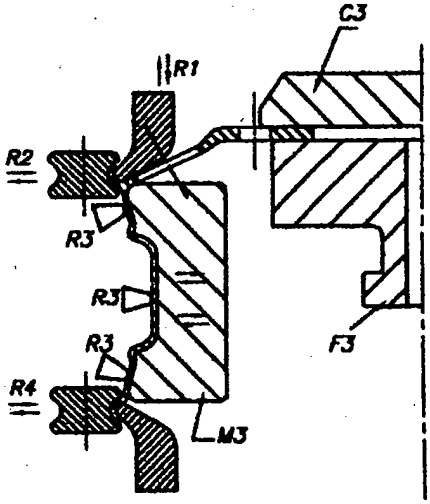


FIG.16

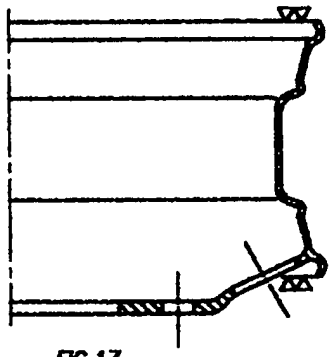


FIG.17

ONE PIECE WHEEL OF 15° DROP CENTRE RIM

SIGNATURE OF APPLICANT: (S. SRIVATHSAN)

NAME OF THE APPLICANT: WHEELS INDIA LIMITED